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Arizona Climate Change Advisory Group

Pending Policy Option Descriptions

June 22, 2006 CCAG Meeting

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Table 1.
Energy Supply Technical Work Group
Summary List of Pending Policy Options

#	Policy Name	GHG Savings ($MMtCO_2e$)	Cost Effectiveness ($\$/tCO_2e$)	
ES-1	Environmental Portfolio Standard / Renewable Energy Standard and Tariff	1a(1) 2010: 1.39 2020: 8.0 1c 2010: 4.19 2020: 16.4	$8 $6	Pending
ES-2	Public Benefit Charge Funds *(1 mill/kWh for Distributed Renewable Gen.)*	2010: 1.46 2020: 4.1	$280	Pending
ES-5	Generation Performance Standards	2010: 5.63 2020: 10.2	$29	Pending
ES-6	Carbon Intensity Targets	2010: 0.0 2020: 14.0	$44	Pending
ES-8	CO2 Tax *(at $5)* CO2 Tax *(at $15)*	2010: 0.53 2020: 2.4 2010: 0.06 2020: 5.4	$3 -$2	Pending

ES-1 Environmental Portfolio Standard / Renewable Energy Standard and Tariff (REST)

Policy Description:

An environmental portfolio standard (EPS) is a requirement that utilities must supply a certain percentage of electricity from environmentally friendly sources. An EPS differs from a Renewable Portfolio Standard (RPS) in that an EPS can include more options than renewables for meeting the requirement. Utilities can meet their requirements by purchasing or generating environmentally friendly electricity or by purchasing clean energy credits. By giving utilities the flexibility to purchase clean energy credits, a market in these credits will emerge that will provide an incentive to companies that are best able to generate clean energy, either through energy efficiency or renewables. Other options for meeting the requirement are possible depending on how the EPS is structured. For example, a provision can be included so that funding for research and development is applied toward meeting a utility's commitment.

Policy Designs:

The TWG analyzed five policy designs:

ES-1a(0): The likely changes by the Arizona Corporations Commission (ACC) to the EPS applied only to ACC-jurisdictional utilities: 5% in 2015, 15% in 2025; Starting in 2007, 5% of the total renewable requirement must be from distributed renewables, increasing to 30% by 2011 and remaining at 30% in future years. Renewable Energy Credit (REC) trading is allowed, provided that all other associated attributes are retired when applying RECs to the Annual Renewable Energy Requirement; out-of-state resources can be used provided that the necessary transmission rights are obtained and utilized.

ES-1a(1): **The ACC's likely changes to the EPS, with SRP continuing with its proposed renewable investments**. The SRP has set a target to generate 15% of its electricity from renewable resources by 2025.

ES-1a(2): The ACC's likely changes to the EPS extended statewide.

ES-1b: Alternative scenario for ACC jurisdictional utilities: 1% in 2005, increasing 1% each year to 26% in 2025. Allow out-of-state renewables and REC trading.

ES-1c: Alternative scenario extended statewide.

- **Goal levels:** As noted above.
- **Timing:** As noted above.

- **Parties:** Utilities as noted above.
- **Other:** Apply a least-cost approach, reflecting resource availability constraints, to determine which renewable energy resources and technologies would be used to meet the EPS beyond the specific requirements laid out in the proposals.

Implementation Method(s):

An EPS is usually implemented through a regulatory requirement (mandate) on the applicable utilities.

Related Policies/Programs in Place:

In the existing EPS, utilities (not including SRP) must generate a specified percentage of their total retail sales from renewable energy:

- Started in 2001 at 0.2% and increased annually to 1% in 2005 and will increase to 1.1% in 2007. Expires in 2012.
- 2001–2003: 50% of current EPS requirement must be solar electric; remainder can be other environmentally friendly technologies including no more than 10% R&D.
- 2004–2012: 60% of resources must be solar electric.
- Environmental Portfolio Surcharge of $0.000875 per kWh with caps by customer class.

Type(s) of GHG Benefit(s):

- CO2: By creating a substantial market in renewable generation, an EPS can reduce fossil fuel use in power generation, and correspondingly reducing CO2 emissions
- Black Carbon: To the extent that generation from coal and oil is displaced by renewables, black carbon emissions will decrease.

Estimated GHG Savings and Costs per MTCO2e:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-1	RE/Std/Tariff, ES-1a(0)	ACC Proposal alone	0.80	4.4	26	331	13

ES-1	RE/Std/Tariff, ES-1a(1)	ACC Proposal + SRP program	1.39	8.0	47	366	8
ES-1	RE/Std/Tariff, ES-1a(2)	ACC Proposal Statewide	1.42	7.7	46	538	12
ES-1	RE/Std/Tariff, ES-1b	Alternative Proposal for ACC Utilities	2.31	9.2	65	281	4
ES-1	RE/Std/Tariff, ES-1c	Alternative Proposal Statewide	4.19	16.4	116	752	6

Data Sources, Methods and Assumptions:

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. A trajectory of MWhs needed to satisfy the REST requirement was calculated, both for central renewable generation and distributed renewables. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, distributed solar PV, distributed solar thermal, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). We assumed that 75% of the Renewable Energy Standard and Tariff (REST) requirement would be met through REC trading. We also assumed that corresponding CO2 reductions would be bundled with the RECs and count toward the emission reduction performance of this policy. We assumed a $5 per MWh REC price, which is consistent with available low-cost wind and other renewable resources in the West and is consistent with REC price assumptions in Integrated Resource Plans by various western utilities as reported in *Balancing Cost and Risk: The Treatment of Renewable Energy in Western Utility Resource Plans* (August 2005, Lawrence Berkeley National Laboratory). The model found the least-cost mix of renewables, constrained by available resources, to satisfy 25% of the central renewable requirement. An assumption that the distributed renewable requirement will be met by 50% solar PV and 50% solar thermal was made. Each renewable was also defined by the share of generation it displaces from NGCT, NGCC, and coal. The model then determines how many MWhs of NGCT, NGCC and coal would be displaced and the

corresponding CO_2 emissions. The model also tracks the cost of generation for renewables and the displaced fossil; the present value of the difference is reported above.

- **Key Assumptions:** Cost and performance characteristics of generating technologies; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions are incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs:

- Reductions in overall energy consumption and the shift from fossil fuel generation as a result of an EPS will lead to reductions in criteria air pollutants and, consequently, lower health impacts and costs associated with those pollutants.
- Water use may be reduced through renewable versus combustion technologies.
- While much of the EPS requirement will come from low-cost renewables such as wind and biomass, meeting the requirement may lead to a moderate increase in direct costs to utilities implementing the EPS policy and a small increase in overall electricity system cost for Arizona. At the same time, investment in new technologies resulting from the EPS may spur economic development and corresponding job growth, and to the extent the renewable energy is derived from Arizona-based capital projects, generate additional local tax revenues.

Feasibility Issues:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

ES-2 Public Benefit Charge Funds

Policy Description:

A public benefit fund (PBF) is a state fund dedicated to support energy efficiency (EE) and renewable energy (RE), funded through a per kiloWatthour charge on electricity sales. To date, nineteen states have implemented PBF programs. A small charge rate, typically in the 2 to 5 mils per kWh range, is applied to electricity sales in the state and collected by a PBF manager. Funds are typically used to support EE and RE in a number of ways, such as through public education, R&D, demonstration projects, direct grants/buy-downs/tax credits to subsidize advanced technologies, and low interest revolving loans. Funding goes to the residential, commercial and industrial sectors. Fund managers decide which technologies to support based on criteria such as GHG reduction potential, cost-effectiveness, co-benefits, etc.

Policy Design:

Introduce a 4 mills ($0.004) per kWh charge to be applied as determined by an authorized entity, probably the ACC. For the purposes of analysis, we assume that 1 mill per kWh is available for distributed renewable generation; the remaining portion of the fund is applied to energy efficiency projects and is quantified by the RCI TWG. We assume that 50% of renewable funding supports solar photovoltaics and 50% supports solar thermal technologies. The total sum raised would be approximately $100-145 million per year for distributed renewables.

- **Goal levels:** As noted above.
- **Timing:** ASAP.
- **Parties:** Public Benefit Fund Manager created by legislature. Utilities will collect the charges from customers and transfer to the Fund Manager. Fund Manager will distribute money to be implemented at the residential, commercial and industrial levels.

Implementation Method(s):

- Funding mechanisms and or incentives
- Pilots and demos
- Research and development
- Education

Related Policies/Programs in Place:

There is no PBF in place in Arizona.

Type(s) of GHG Benefit(s):

- CO2: By spurring investment in energy efficient technologies and small-scale renewable generators, PBF programs reduce the need for generation from fossil fuel plants, which can lead to a significant reduction in GHG emissions.
- Black Carbon: To the extent that generation from coal and oil is displaced by energy efficiency and renewables, black carbon emissions will decrease.

Estimated GHG Savings and Costs per MTCO2e:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-2	Public Benefits Fund	(Distributed Renewables only)	1.46	4.1	34	9383	280

Data Sources, Methods and Assumptions:

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sargent & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. This policy was partly analyzed by the RCI TWG. We assumed that 1 mil per kwh of the 4 mils charge in this policy would be devoted to distributed renewable generation. The 1 mil per kwh charge was applied to the reference case forecast of electricity generation to determine the total annual funding available. We assumed that half of the funding would go toward PV and half toward solar thermal. The funding would cover the difference between the cost of distributed renewables and the retail cost of electricity, reflecting the incremental funding needed to achieve the investment. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. The model calculated the PV and solar thermal generation resulting from the PBF funding. Each distributed renewable was also defined by the share of generation it displaces

from NGCT, NGCC, and coal. The model then determined how many MWhs of NGCT, NGCC and coal would be displaced and the corresponding CO2 emission reductions. The model also tracks the cost of generation for renewables and the displaced fossil; the present value of the difference is reported above.

- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

- As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions were incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs:

- Reductions in overall energy consumption and the shift from fossil fuel generation as a result of a PBF will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.
- Water use may be reduced through renewable versus combustion technologies.
- Much of the investment made by the PBF will go into zero- or low-cost (even negative-cost) energy efficiency and small-scale renewables, and the PBF program can more than pay for itself through cost-effective investments. Nevertheless, the impact on the larger electricity system of the PBF program can lead to a small increase in overall electricity system cost. At the same time, though, investment in new technologies resulting from the PBF could spur economic development in Arizona.

Feasibility Issues:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

ES-5 Generation Performance Standards

Policy Description:

A generation performance standard (GPS) is typically a requirement that electricity utilities or load serving entities (LSE) sell electricity with an average emission rate below a specified mandatory standard. Utilities must take action to ensure that their generation mix meets the standard.

A variation of a GPS is to incorporate the standard within a cap and trade system in which permits are allocated by dividing the total cap by the total number of MWhs generated to arrive at the performance standard. Permits are then given to each participant based on its own generation multiplied by the performance standard. Generators with emission rates lower than the GPS would receive more allowances than they need. Generators with emission rates higher than the GPS would receive fewer allowances than needed. As electricity generation increases, everything else being equal, the number of permits per MWh would decline because of the cap.

A third variation of a GPS is to establish the standard and allocate allowances based on that standard every year. In this variation, as electricity generation increases, plants would receive more permits. Utilities could trade permits in order to achieve the standard, but there would be no fixed cap on emissions. This variation provides a financial incentive (via trading) for generators to reduce emissions so that they can sell unneeded permits to generators who have high emissions.

Policy Design:

Apply a GPS only to new generation. As new capacity comes on-line, those plants would receive an allocation based on the GPS standard. Utilities could trade permits in order to achieve the standard, but there would be no fixed cap on emissions. The GPS level would be equivalent to a new natural gas combined cycle plant. Assessment of this option should consider that new electricity demand in Arizona might be served, at least in part, by out-of-state resources. Accordingly, analysis of this option should consider how a GPS policy might affect decisions to build new capacity inside or outside of Arizona.

- **Goal levels:** Set a GPS equivalent to a new natural gas combined cycle plant applicable to new supply, whether generated in Arizona or imported.
- **Timing:** As new generation capacity is built or power is imported.
- **Parties:** Utilities (electricity generators).

Implementation Method(s):

- Market based mechanisms with underlying regulatory obligation.

Related Policies/Programs in Place:

- No GPS system is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO2: A GPS program is a direct limit on CO2 emissions. The level of the standard determines reductions.
- Black Carbon: To the extent that generation from coal and oil declines under a GPS program, black carbon emissions will also decrease.

Estimated GHG Savings and Costs per MTCO2e:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-5	Generation Performance Standard	All new supply (generated or imported) as clean as NGOC	5.63	10.2	104	2980	29

Data Sources, Methods and Assumptions:

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sergeant & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGOC), and natural gas combustion turbines (NGOC). The reference case forecast of electricity generation was the starting point for this analysis. We assumed that existing resources would continue to operate in the state over the analysis period. We subtracted generation from existing resources from the reference forecast of total generation to find a new generation forecast. The model then found the least-cost mix of new

generation needed, subject to the constraint that all new generation must have an equal or lower emission rate than new natural gas combined cycle plants. The model tracks cost and CO2 emissions associated with new generation. We also ran the model without constraints to develop a reference case. We then calculate the difference in CO2 emissions and total cost of generation between the policy case and the reference case. Those results are reported above.

- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; any transmission and distribution modeled.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions were incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs:

- The shift from fossil fuel generation as a result of a GPS system will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.

Feasibility Issues:

None cited.

Status of Group Approval:

Pending.

Level of Group Support:

TBD

Barriers to Consensus:

TBD

ES-6 Carbon Intensity Targets

Policy Description:

Rather than a fixed cap on carbon emissions, a carbon intensity target is a limit on the ratio of carbon emissions to a measure of output. Absolute emissions can increase as output increases. Measures of output are clear for some sectors like electricity generation (e.g., MWh), but can difficult for other sectors (e.g., manufacturing). One measure of output for other sectors could be dollars equal to the value of the output.

Policy Design:

Arizona implements a mandatory carbon intensity target that begins in 2010 (equal to carbon intensity in 2010) and that declines by 3% annually through 2025. The carbon intensity target is translated annually into a cap, and trading is allowed under that cap.

- **Goal levels:** As noted above.
- **Timing:** As noted above.
- **Parties:** Utilities and electric generators.

Implementation Method(s):

- Market based mechanisms with underlying regulatory obligation.

Related Policies/Programs in Place:

- No carbon intensity target is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO_2: A carbon intensity target may or may not reduce CO_2 emissions. A stringent intensity target is more likely to lead to reductions than a lenient target. A less stringent target may curb growth in emissions, but not reduce absolute emissions.
- Black Carbon: To the extent that generation from coal and oil declines under a carbon intensity target, black carbon emissions will also decrease.

Estimated GHG Savings and Costs per $MTCO_2e$:

			Reductions ($MMTCO_2e$)		

#	Policy	Scenario	2010	2020	Cumulative Reductions (2006 - 2020)	NPV (2006–2020) $ Millions	Cost-Effective-ness $/tCO2
ES-6	Carbon Intensity Target	Intensity improvement of 3%/year 2010-2025	0.00	14.0	70	3119	44

Data Sources, Methods and Assumptions:

- **Data Sources:** CDEAC, WECC, EIA, EPA, Arizona Solar Energy Center, "*Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Forecasts*" by Sergeant & Lundy.
- **Quantification Methods:** A simple capacity expansion model was developed in Excel specifically for this policy option. Renewable and fossil technologies were characterized in terms of cost and operating profiles, and available resources in the state were also defined. Technologies include three classes of wind, concentrating solar power, geothermal, biomass, landfill gas, conventional coal, integrated gasification combined cycle with carbon capture and storage (IGCC with CCS), natural gas combined cycle (NGCC), and natural gas combustion turbines (NGCT). The reference case forecast of electricity generation was the starting point for this analysis. We assumed that existing resources would continue to operate in the state over the analysis period. We subtracted generation from existing resources from the reference forecast of total generation to find a new generation forecast. The model then found the least-cost mix of new generation needed, subject to the constraint that CO2 emissions not exceed the limit imposed by the carbon intensity target. The model tracks cost and CO2 emissions associated with new generation. We also ran the model without constraints to develop a reference case. We then calculate the difference in CO2 emissions and total cost of generation between the policy case and the reference case. Those results are reported above.
- **Key Assumptions:** Cost and performance characteristics of generating technologies now and in the future; resource availability; no demand response as a result of policy; no transmission and distribution modeled.

Key Uncertainties:

- As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions listed above. If those assumptions were incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs:

- The shift from fossil fuel generation as a result of a carbon intensity target will lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.

Feasibility Issues:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

ES-8 CO2 Tax

Policy Description:

A CO_2 tax is a tax on every ton of CO_2 emitted. Companies would either pass the cost on to consumers, change production to lower emissions, or a combination of the two. Either way, consumers would see the implicit cost of CO_2 emissions in products and services and would adjust behavior to purchase substitute goods and services that result in lower CO_2 emissions. Typically, a CO_2 tax is put in place with an income tax reduction to offset the economic impact of the new tax. CO_2 tax revenue could go completely to income tax reductions or part of it could go toward policies and programs to assist with CO_2 reductions.

Policy Design:

Adopt a flat $5 per ton economy-wide, upstream CO_2 tax, analyzing this tax as if adopted on a national basis and evaluating the resulting impact on Arizona. Other levels (such as $10/ton and $15/ton) may be assessed if resources permit so as to consider elasticity in costs and GHG reductions. Some members of the CCAG expressed concern about moving forward with analyzing this option.

- **Goal levels:** As noted above.
- **Timing:** Not considered.
- **Parties:** All (economy-wide).

Implementation Method(s):

- Market-based (economic) mechanism with underlying legal obligation.

Related Policies/Programs in Place:

- No CO_2 tax is in place in Arizona.

Type(s) of GHG Benefit(s):

- CO_2: A CO_2 tax is a disincentive to emit CO_2 emissions. Producers and consumers will adjust behavior to avoid the tax and thereby reduce CO_2 emissions in the process.
- Black Carbon: To the extent that generation from coal and oil declines under a CO_2 tax, black carbon emissions will also decrease.

Estimated GHG Savings and Costs per MTCO2e:

#	Policy	Scenario	Reductions (MMTCO2e)			NPV (2006–2020) $ millions	Cost-Effective-ness $/tCO2
			2010	2020	Cumulative Reductions (2006 - 2020)		
ES-8	CO2 Tax	$5/ton upstream tax, results are for electricity only	0.53	2.4	11	30	3
ES-8	CO2 Tax	$15/ton upstream tax, results are for electricity only	0.06	5.4	28	-70	-2

Data Sources, Methods and Assumptions:

- **Data Sources:** Data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes Assumptions to the Annual Energy Outlook that details key assumptions in the current version of the model. EIA also publishes NEMS model documentation.
- **Quantification Methods:** We applied a tax of $5 per ton CO2 to electricity generators at the national level. CO2 reductions were found by comparing emissions from the policy case to emissions from a reference case. Costs were estimated by comparing policy and reference case new generating capacity investments, operating and maintenance costs for all generation, fuel costs for all generation, and transmission and distribution costs for all generation. The reported cost for the policy is the net present value of the difference in the above costs between the policy and reference cases. Because the NEMS model captures the CO2 tax in the price of fuel, we simply substituted the reference case price of fuel for the policy case price of fuel, which reflects the CO2 tax. In treating CO2 tax revenues in this way, we implicitly assumed that the revenues would be recycled back to Arizona. However, we did not distinguish how the revenue would be recycled, nor did we capture any macroeconomic effects of recycling. The costs reported are the direct social cost of the policy (not accounting for macroeconomic impacts), not the cost to utilities and ratepayers, which depends

on whether and how revenues are recycled. Because the NEMS model is a national model with multi-state regions (Arizona is within the Rocky Mountain Power Area), the results for Arizona were derived from results in the region. We shared out the regional emission and cost results according to the share of Arizona generation within the region.

- **Key Assumptions:** Any analysis of state-level policies using the National Energy Modeling System (NEMS) from the US Energy Information Administration should be weighed carefully. NEMS is a national model that consists of 13 regions. State policies cannot be implemented explicitly within NEMS, and the state-specific impacts cannot be known explicitly. We must make assumptions about the impact of policies at the state level by sharing out regional results. In reality, the state-level changes resulting from policy may differ substantially from the changes in the region.

Key Uncertainties:

As with any assessment of the future, this analysis has many uncertainties. Key uncertainties are related directly to the key assumptions and quantification methods listed above. If those assumptions were incorrect, then the results would change. Other uncertainties include the forecast of the price of fossil fuels and the growth in the demand for electricity.

Ancillary Benefits and Costs:

- The shift from fossil fuel generation that would result from a CO2 tax would lead to reductions in criteria air pollutants and, consequently, health impacts and costs associated with those pollutants.
- Shifting from an income tax to a CO2 tax could have economic benefits by encouraging productive activity and discouraging harmful emissions.

Feasibility Issues:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

Table 2.
Residential Commercial and Industrial Technical Work Group
Summary List of Pending Policy Options

#	Policy Name	GHG Savings ($MMtCO_2e$)	Cost-Effectiveness ($\$/tCO_2e$)	Status
RCI-12	Solid Waste and Wastewater Management	2010: 2.21 2020: 3.69	Not Quantified	Pending
RCI-13	Water Use Management	2010: 0.23 2020: 0.77	Not Quantified	Pending

RCI-12 Solid Waste Management

Policy Description:

This policy option considers several options to increase recycling and reduce waste generation in order to limit greenhouse gas emissions associated with landfill methane generation and with the production of raw materials.

Policy Design:

In 2005, over 3 million residents in 39 Arizona communities had access to residential curbside recycling, representing slightly over 50% of the state's population. To further increase the diversion of waste from landfill and the amount of materials recycled, the State should aim to:

- Ensure that curbside recycling programs are provided in all communities over 50,000 in population;
- Increase the penetration of recycling programs in multi-family dwellings;
- Create new recycling programs for the commercial sector;
- Increase average statewide participation/recovery rates for all existing recycling programs; and,
- Develop a statewide recycling goal.

Implementation Method(s):

Implementation options that should be considered include:

- **Expansion of ADEQ Waste Reduction Assistance (WRA) grants**. Grants can target projects that include new or expanded curbside recycling programs. Grants for new and expanded recycling programs to help overcome initial cost barriers faced by communities;[1]
- **Mandatory source separation and recycling laws or ordinances in urban areas.** Municipalities in several states require households or businesses to use recycling containers or services for targeted materials (e.g. office paper, home recyclables).[2] Some AZ solid waste experts feel that such measures may be needed if participation

[1] In 2006, four of the six awards were to communities for such projects.
[2] For instance, participants using standard waste containers for targeted items may be issued warning notices and/or fines for non-compliance.

rates are to be increased, and suggest starting with banning of landfill disposal of consumer electronics (a toxics hazard) to evaluate feasibility;

- **Tax breaks or other incentives** to make recycling financially attractive for private commercial sector waste haulers;
- **Full recycling as a contract requirement for state facilities**;
- **Government purchasing requirements for recycled content** of items purchased (paper, carpets, etc.);
- **Waste education campaign**, aiming at waste reuse and reduction, and targeting greenhouse gas reductions; and,
- **General awareness building**, e.g., working with community leaders to appreciate benefits and cost-effectiveness of curbside recycling.

Related Policies/Programs in Place:

See above.

Types(s) of GHG Benefit(s):

Waste prevention and recycling (including composting) divert organic wastes from landfills, thereby reducing the methane released when these materials decompose. Manufacturing goods from recycled materials typically requires less energy than producing goods from virgin materials. Waste reduction and reuse means less energy is needed to extract, transport, and process raw materials and to manufacture products.[3]

Estimated GHG Savings and Costs per Ton (for quantified actions):

Total for Policy			
GHG Emission Savings	**2.21**	**3.69**	MMtCO2e
Net Present Value (2006-2020)		not est.	$million
Cumulative Emissions Reductions (2006-2020)		36	MMtCO2e
Cost-Effectiveness		not est.	$/tCO2e

Note that about 15% of the above savings is estimated to be from avoided emissions from land filling (largely avoided methane release), and these savings should occur within the state. The other 85% is associated with avoided emissions related to the lower life cycle emissions of recycled compared with virgin products (wood harvesting, pulp and paper processing, transportation). To the extent that paper is manufactured outside the state, these emissions reductions will also occur outside the state.

Data Sources, Methods and Assumptions:

[3] Adapted from USEPA. See website for further details: http://yosemite.epa.gov/OAR/globalwarming.nsf/content/ActionsWasteBasicInfoGeneral.html

- **Data Sources:** Key data sources include ADEQ (recycling amounts), USEPA studies (results from studies of life-cycle GHG emissions associated with managing waste materials)
- **Quantification Methods:** Assumes above efforts can increase amount of paper recycled by 600,000 short tons by 2010 and 1,000,000 short tons by 2020. Benefits from increased recovery of other materials not yet considered.
- **Key Assumptions:** Assumes national average landfill practices (methane recovery), transport distances, and waste composition (in a given category).

Key Uncertainties:

Key uncertainties are related to the feasibility and impact of the above recommendations.

Ancillary Benefits and Costs:

These could include:

- Reduction in environmental impacts related to disposal of wastes that are recycled and/or composted
- Income from sales of recycled materials, savings from avoided cost of landfill tipping fees
- Reduction of impacts related to manufacturing of new materials through recycling
- Local economic benefits from businesses engaged in recycling or reuse-related activities

Feasibility Issues:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

RCI-13 Water Use and Wastewater Management

Policy Description:

A considerable amount of energy is used to pump, treat, and deliver water across the state. This policy options aims to reduce energy consumptions by reducing overall water use and improving the efficiency of water supply and wastewater facilities.

Policy Design:

The State currently uses about 7.7 million acre-feet (MAF) of water, 77% of which is delivered to agricultural consumers, 18% to municipal consumers, and the remainder to industrial users. A significant amount of energy is used to pump this water from underground aquifers (3.6 MAF), from the Colorado River (2.6 MAF), and other sources (1.2 MAF), and to treat it in wastewater facilities after it is used.[4] Five specific recommendations are provided below, along with an overall state water use reduction goal.

1. Accelerate investment in water use efficiency: Implement best management practices and efficient water management practices, and provide incentives for implementation of water management improvement measures. Coordinate with the investments in energy efficiency (RCI-1). Start in the areas of the state with most energy-intensive water use cycles. Consider developing a statewide water and wastewater savings plan, based on a thorough assessment of water and wastewater options in all water using sectors.
2. Increase the energy efficiency of all water and wastewater treatment operations. Develop long-term programs to better mesh with the long-term investments in water and wastewater infrastructure. For example, for water pumping, in particular, two specific options are worth considering:[5]
    - Pump Testing Program. A large amount of energy is likely expended by a small number of older well pumps that are often run until they failure, many years after it would be economic to replace them. Incentives combined with

[4] Other sources include the Salt and Gila Rivers. For a good description of the state's water sources and uses, see http://www.tceq.state.tx.us/assets/public/compliance/R15_Harlingen/US-MX%20BGC%20Water%20table%20documents/US%20States/Arizona/bgc_resources_and_issues_presentation_final.ppt

[5] Thanks go to Chico Hunter of SRP for valuable inputs on this option.

the provision of energy efficiency information through the existing DWR pump testing program could lead to significant energy savings.

- Encouraging Pump Design/Planning/Maintenance Best Practices Study in Rapidly Growing Areas. Many municipalities, especially small but rapidly growing cities, lack the experience or resources to optimize the specifications of new pumps to reduce energy consumption. An effort to benchmark effective pump specification, management, and maintenance procedures across municipalities and to share best practices with emerging cities could yield large savings.

3. Increase energy production by water and wastewater agencies from renewable sources such as in-conduit hydropower and biogas. Add generation from solar and wind resources to water and wastewater projects where applicable.
4. Encourage and create incentives for technologies with the capability to reduce water use associated with power generation. Included would-be zero- or low-water-use technologies and renewable energy technologies, as well as energy efficiency technologies that reduce electricity consumption.
5. Ensure that power plants use the best management practices and economically feasible technology available to conserve water (via siting, evaluation, permitting or other processes).

Implementation Method(s):

Specific implementation strategies are to be determined.

Related Policies/Programs in Place:

The AZ Department of Water Resources maintains a number of water management programs and policies.[6]

Types(s) of GHG Benefit(s):

GHG benefits (primarily CO_2) would result from avoided fuel and electricity consumption for pumping, treating, and delivering water.

Estimated GHG Savings and Costs per MTCO2e:

[6] See e.g., http://www.tceq.state.tx.us/assets/public/compliance/R15_Harlingen/US-MX%20BGC%20Water%20table%20documents/US%20States/Arizona/bcgwater_admin_overview.doc

Illustrative Estimates

Total for Policy			
GHG Emission Savings	**0.23**	**0.77**	MMtCO2e
Net Present Value (2006-2020)		not est.	$million
Cumulative Emissions Reductions (2006-2020)		6	MMtCO2e
Cost-Effectiveness		not est.	$/tCO2e

This analysis illustrates very roughly the magnitude of GHG savings that might result if state water use could be reduced by 10% compared with current usage levels by 2020 (i.e. by 0.8 MAF). Note that improvements in pump efficiency would provide GHG savings over and above this level; however, pump efficiency improvement potentials may already be partly taken into account in RCI-1 (for electric pumps only).

Data Sources, Methods and Assumptions:

See the attachment at the end of this document for a more detailed listing of methods, data sources, and assumptions. Sufficient information for cost-effectiveness assessment is not available. In summary:

- **Data Sources:** Arizona Department of Water Resources (water use levels) and California State Agencies (energy use and GHG emissions related to water use).
- **Quantification Methods:** The above estimate assumes a 10% water savings (relative to current levels) is achieved by 2020 (3% by 2010), and that 1 MtCO2e could be avoided for each MAF saved (based on CA estimates).
- **Key Assumptions:** The key assumption is that a 10% water savings is achievable by 2020.

Key Uncertainties:

Key uncertainties are related to the feasibility and impact of the above recommendations.

Ancillary Benefits and Costs:

These could include:

- The ancillary benefits and costs described for other energy efficiency options (see RCI-1)
- Reduced cost of electricity for water pumping displaced fuels costs for users of landfill gas and captured gas from waste treatment facilities.
- Central-station power plant cooling water savings
- Reducing dependence on imported fuel sources, and reducing vulnerability to energy price spikes

Feasibility Issues, if applicable:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

Table 3.
Transportation and Land Use Technical Work Group
Summary List of Pending Policy Options

#	Policy Name	GHG Savings (MMtCO2e)	Cost-Effectiveness ($/tCO2e)	Status
TLU-2 (and TLU-3)	Smart Growth Bundle of Options (incorporates previous TLU-3 Promoting Multimodal Transit)	2010: 0.6-3.2 2020: 0.7-4.0	Net Savings	Completed TLU-2; TLU-3 Pending
TLU-6	Fuel Tax	Not quantified	Not quantified	Pending
TLU-7	Hybrid Promotion and Incentives	2010: .003-.004 2020: .033-.048	Not quantified	Pending
TLU-8	Feebates	Not quantified	Not quantified	Pending
TLU-9	Pay-As-You-Drive Insurance	2010: ~0 2020: 2.8	Zero net cost	Pending
TLU-10	Low Rolling Resistance Tires	2010: n/a 2020: 0.8	Not quantified	Pending
TLU-11	Accelerated Replacement/ Retirement of High-emitting Diesel Fleet	2010: 0.9-0.18	Not quantified	Pending
TLU-12	Biodiesel Implementation	2010: 0.11 2020: 1.08	Not quantified	Pending
TLU-13	State Lead-By-Example (via Procurement and SmartWay)	Not quantified	Not quantified	Pending
TLU-14	60 mph Speed Limit for Commercial Trucks	Not quantified	Not quantified	Pending

TLU-2 (and TLU-3) Smart Growth Bundle of Options

Policy Description:

This bundle of options encompasses four components related to reducing GHG emissions through land use practices and policies. These policies contribute to GHG emission reductions by reducing vehicle trips and total vehicle miles traveled.

Policy Design:

Smart growth actions include the following programs and program elements:

- **Infill and Brownfield redevelopment.** Shifting housing and commercial development toward location efficient sites, such as brownfields and infill projects, and away from location inefficient sites, such as greenfields, can reduce overall travel demand and expand lower emitting mode choices. Brownfields are commercial or industrial properties that are abandoned or are not being fully used because of actual or perceived environmental contamination. These properties have potential for redevelopment, but the uncertainty and risk of environmental liability and the cost of investigation and cleanup keep them from being redeveloped. Brownfields can be former industrial properties, abandoned gas stations, vacant warehouses, or former dry-cleaning establishments. Redevelopment of these environmentally contaminated properties creates jobs, revitalizes neighborhoods, increases property and sales tax revenues, decreases urban sprawl, and reduces potential health risks to the local community. Infill development can also revitalize neighborhoods, increase tax revenues, and decrease urban sprawl.
- **Transit-oriented development (including multi modal transit proposals previously covered under option TLU-3)** includes a shift to lower emitting mode choices by building compact development around transit stops to meet daily needs by foot, bicycle, or transit and/or by clustering employment centers around transit stops.
- **Smart growth planning,** modeling, and tools includes a number of practices aimed at encouraging location efficient growth in communities that are proximate to household amenities (such as jobs, shopping, school, services, entertainment, etc.) as opposed to growth in areas that are not proximate and require greater travel distance and have less mode choice. Smart growth allows for mixed land uses within a project with a range of housing opportunities and multiple transportation options including pedestrian/bike access.

- **<u>Targeted open space protection</u>** includes programs designed to protect and conserve State lands and other open spaces, and develop and improve neighborhood, community, and regional parks in ways that encourage location efficient growth and broader mode choice.
- **<u>Promote multimodal transit (including multi modal transit proposals previously covered under option TLU-3)</u>** and promote shifts in passenger transportation mode choice (auto, bus, rail, bike, pedestrian, etc.) to lower emitting choices, and includes: make optimal use of CMAQ funds; expand transit infrastructure (rail, bus, BRT); improve transit service, promotion, and marketing (including tax-free Commuter Benefits); improve bike and pedestrian infrastructure; explore commuter rail using existing rail corridors; consider re-establishing train service between Phoenix and Tucson; review all proposed transportation projects for multi-modal flexibility (e.g., add BRT or light rail if feasible); conduct research into new transportation technologies and urban planning techniques.

Goal levels: Target a reduction in growth in VMT from passenger vehicles of 2%-11% in the years 2007-2020 through a combined approach utilizing a number of programs that fall under those listed above.

Implementation Method(s):

Specific policy measures would include:

- Promote use of authority under Growing Smarter/Plus by counties to impose development fees consistent with municipal development fee statutes.
- Promote smart growth principles in new development by requiring bidders to include defined smart growth principles in bid packages.
- Promote use of authority under Growing Smarter/Plus by cities to create infill incentive districts and plans that could include expedited process incentives.
- Promote use by cities of a fee waiver system, similar to Phoenix Infill Housing Program, to encourage development of single-family owner-occupied housing on vacant, orphaned, or underutilized land located in the mature portions of Arizona.
- Provide technical assistance to communities that want to pursue Smart Growth and disseminate lessons learned in cities such as Phoenix and Tucson.
- Provide Smart Growth information tools that identify the qualitative (e.g., improved quality of living) and quantitative benefits (e.g., reduced vehicle operation costs) of these Smart Growth communities.
- Encourage lenders to apply location-efficient mortgage principles, so transportation cost savings is recognized when calculating a household's borrowing ability.

- Encourage cities to review (and update where appropriate) their engineering plans and standards to make new road and sidewalk infrastructure friendlier to bikes and pedestrians.
- Promote telecommuting.[7]
- Promote affordable housing in new developments.
- Carefully review land swaps that lead to undesirable development patterns.
- Implement the vision set forth in the MoveAZ report.

Related Policies/Programs in Place:

For many years, Arizona and various counties and cities have pursued a variety of policies related to Smart Growth (e.g., Growing Smarter legislation and actions by Phoenix and Tucson). In addition, in 2004, the Arizona Department of Transportation completed a long-range transportation plan for the state entitled MoveAZ (www.moveaz.org). Adopted by the State Transportation Board, MoveAZ provides policy directions, performance-based evaluations of capital transportation projects, and tools for ADOT to use in planning and implementing a vibrant multi-modal transportation system for the state. If successful, these efforts will complement the other actions in the Smart Growth bundle and help it achieve VMT reductions more toward the upper range of estimates for that option.

Types(s) of GHG Benefit(s):

CO2 reductions

Estimated GHG Savings and Costs Per MTCO2e:

	2010	2020	Units
GHG Emission Savings (2% case) (11% case)	0.6 3.2	0.7 4.0	MMtCO2e
Net Present Value (2006-2020)		Net savings	$ million
Cumulative Emissions Reductions (2006-2020)		Not quanitfied	MMtCO2e
Cost-Effectiveness		Net savings	$/tCO2e

[7] There was also a suggestion of Hybrid access to HOV lanes, but this will go elsewhere, not part of Smart Growth

Data Sources, Methods and Assumptions:

- **Data Sources:** CCS, Arizona Greenhouse Gas Inventory and Reference Case Projections, 1990-2020, March 2006. Extensive Smart Growth literature.
- **Quantification Methods:** Modified AZ reference cast forecast for 2008-2020 using 2% - 11% reduction in VMT.
- **Key Assumptions:** The value used for reduction in VMT. Also assumes de minimus increases in GHG emissions from increased use of alternate transit modes. Assumes that infrastructure savings offset other costs.

Key Uncertainties:

Sensitivity of VMT growth to policy shifts.

Ancillary Benefits and Costs:

Reduced infrastructure costs, avoided health care costs via reduced air pollution and increased walking/biking, other quality-of-life aspects. However, there will be front-end costs of program development and implementation for brownfields, infill, and transit-oriented development programs. A successful program requires dedicated resources to ensure redevelopment is achieved. There are grants available from the EPA that assist with the initial establishment of a program or to fund environmental activities for a specific project; however, successful local and state brownfields programs have a dedicated source of funds for the program. Financial resources are required to fund staff (at least one full-time employee is typical), administrative expenses, promotion, education, etc. on an annual basis, which has averaged approximately $200,000 per year for the City of Phoenix.

Many successful programs have used financial incentives to jump-start private sector investment. As the market increasingly embraces Smart Growth, these may become less necessary. Most federal brownfields programs are not available directly to the private sector; therefore, the most effective programs nationwide provide local or state financial assistance. In the City of Phoenix, capital improvement bond funds are used to provide financial assistance directly to the private sector and to encourage the use of brownfields for public facilities. Phoenix secured $3.4 million from the 2000 Phoenix Bond Program and recently obtained $4 million from the 2006 program for brownfields redevelopment.

Feasibility Issues:

Smart Growth developments sell at a premium.

Status of Group Approval:

Completed for TLU-2, Pending for Multi Modal Transit incorporated from TLU-3

Level of Group Support:

Unanimous for TLU-2

Barriers to Consensus:

None cited for TLU-2

TLU-6 Gas Tax

Policy Description

A tax on gasoline could provide a source of revenues for investment in efficient and low emitting transportation systems that reduce emissions related to passenger vehicles.

Policy Design

A small increase in the gasoline tax could fund low-GHG travel options. With consumption of approximately 95 million barrels per year of gasoline and diesel in 2010, each one-cent increase in the state fuel tax would raise about $40 million. This amount would increase in 2020 to $52 million.

Implementation method:

Activity Tax

Related Policies/Programs in Place:

Existing fuel tax.

Types(s) of GHG Benefit(s):

CO_2, black carbon

Estimated GHG Savings and Costs Per MTCO2e:

Not quantified.

Data Sources, Methods and Assumptions:

Not quantified.

Key Uncertainties:

None cited.

Ancillary Benefits and Costs:

Some reduction in criteria pollutants.

Feasibility Issues:

The group noted significant political barriers to increased gasoline taxes.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

TLU-7 Hybrid Promotion and Incentives

Policy Description:

A combination of public education and information and financial incentives to promote the sales of light duty vehicles with hybrid gasoline-electric power trains.

Policy Design:

- **Goal levels:** An increase of 1% in the hybrid share of the light duty vehicle fleet for the period 2008-2020.
- **Timing:** 2008-2020
- **Parties:** Industry**,** ADEQ, Arizona Department of Revenue

Implementation Methods:

Hybrid promotion and incentive programs would be implemented from the years 2007 through 2020. This covers the time period between the near term years when production is limited and the medium-to-long term years when expansion of production capabilities makes it more likely that promotion and incentive policies will have a significant effect on consumer choices. Some promotion programs could include public education and information and partnership programs. Some incentive programs could include financial incentives such as reduction in fees and taxes for owners of newly purchased hybrid vehicles or giving preferential infrastructure access to hybrids on carpool lanes or metered parking spaces. [IMPORTANT:] The state needs to study further the level and design of incentives necessary to achieve the goal set forth here.

In the near term (2006-2008), the hybrid vehicle sales are constrained on the producer side by an inability of automobile manufacturers to keep up with already existing consumer demand. In the medium-to-long term (2009 forward for Arizona), automobile manufacturers are likely to increase production capabilities for hybrid power train vehicles, and provide consumers with many more choices of hybrid cars. As a result, hybrid promotion and incentive programs are likely to have some incremental positive net effect on consumer purchase behavior.

Related Policies/Programs in Place:

Current law provides for a Federal income tax credit up to $3400 for purchase of a hybrids.

Estimated GHG Savings and Costs Per MTCO2e:

	2010	2020	Units
GHG Emission Savings	0.003-0.004	0.033-0.048	MMtCO2e
Net Present Value (2006-2020)		Not quantified	$million
Cumulative Emissions Reductions (2006-2020)		Not quantified	MMtCO2e
Cost-Effectiveness		Not quantified	$/tCO2e

Data Sources, Methods and Assumptions:

The United States Department of Energy's (USDOE) Oak Ridge National Laboratory (ORNL) projected that total hybrid sales could range from 700,000 to 1.1 million units in 2008 and 1.7 million to 2.5 million units in 2012. CCS estimated that hybrid promotion and incentive programs would be responsible for 1% of total sales that would not have resulted without the programs. CCS also assumed that new light duty vehicle sales in Arizona would continue to be about 2% of total nationwide sales. Given average mileage of Arizona light duty vehicles and the difference in miles per gallon between the hybrid vehicles and conventional gasoline power train vehicles, CCS calculated the estimated amount of gallon savings and resulting reduction in GHG emissions.

The CCS analysis assumes that total automobile sales and manufacturer production plans will be consistent with those assumed in the Oak Ridge National Laboratory study. The quantification analysis assumes that LDV GHG emissions standards consistent with TLU-1 are not in place with model year 2011. The analysis also assumes that the annual mileage for Arizona automobiles stays constant at an average of 13,000 miles, and that hybrid powertrain cars provide a 12.5% to 40% improvement on MPG than comparable conventional cars. In general, the sets of assumptions and methods used would tend to produce a relatively conservative estimate of greenhouse emission reductions.

Key Uncertainties:

There are numerous uncertainties about what influences consumer demand for different types of automobiles. While some consumer education and incentive programs have been shown to have positive impact (e.g. most notably, Energy Star programs), the degree of success of hybrid vehicle promotion and incentive programs is uncertain.

Ancillary Benefits and Costs, if applicable:

None cited.

Feasibility Issues, if applicable:

None cited.

Status of Group Approval:

TBD

Level of Group Support:

TBD

Barriers to Consensus:

TBD

TLU-8 Feebates

Policy Description:

"Multi-State LDV GHG Fee and Rebate Study and Pilot Program." The State of Arizona would participate in funding a multi-state study of "feebate" program benefits and costs, including the neighboring states of California and New Mexico. Feebate proposals usually have two parts--(1) a fee on relatively high emissions/lower fuel economy vehicles and (2) a rebate or tax credit on low emissions/higher fuel economy vehicles.

Policy Design:

The "Multi-State LDV GHG Fee and Rebate Study and Pilot Program" would consider the expected impacts of individual state feebate programs as well as coordinated or consistent multi-state programs. Ideally, such a multi-state study would include a number of western states in order to assess boundary issues and well as coordination issues. Initial analysis suggests that the Arizona new car market, which represents approximately 2% of the United States market, may be too small a share of the market to have an effect on the types of vehicles that manufacturers put into the marketplace. A consistent set of feebate programs across multiple states may include a large enough share of the US market to have a more significant effect on supply side decisions made by automobile manufacturers. The study would also identify and assess the actual benefits and costs of a pilot feebate program to be implemented at the county or metropolitan level in the western United States.

Economic analyses of these proposals have found that feebate programs would work on two levels. First, the feebates would directly affect consumer choices for vehicle purchases as a result of the financial incentives. Second, the feebates could indirectly affect the types of vehicles that automobile manufacturers choose to put into the marketplace.

While feebate proposals have been described in academic studies, there has been no implementation of a full feebate program to date in the United States. While there are individual 'gas guzzler tax' and tax incentives for hybrid vehicle purchases, there is not yet any history of an 'on-the-ground' example of a comprehensively implemented feebate program.

Both the United States Department of Energy and the Canadian Transport Ministry have studied the potential impacts of national level feebate programs in recent years. While these studies have informed the debate about the advantages and disadvantages of national feebate programs, there remains considerable uncertainty about the potential benefits and costs of state or multi-state level feebate programs.

There is an important need for a greater understanding of the potential effects of single state or multi-state feebate programs on the types of vehicles that manufacturers put into the marketplace. Since existing analysis shows that 90% of the benefits of feebate programs are likely to arise from the manufacturing (supply side) response rather than the consumer (demand side) response, it is important to develop a better understanding of where the threshold for manufacturer response lies and the degree of impact of single state and multi-state programs. Some political issues also may arise relating to the potential perception of the fee portion of these programs as additional taxes on motor vehicles.

Implementation Method:

The State of Arizona would fund a cost-shared study with other western states. The study would be jointly funded and administered by the environment agencies and energy agencies of the states that choose to cooperate in this study.

Related Policies/Programs in Place:

None cited.

Estimated GHG Savings and Costs Per MTCO2e:

Not quantified.

Data Sources, Methods and Assumptions:

CCS conducted a review of the most relevant research and analysis on feebate proposals. CCS made three findings:

(1) There has been significant conceptual development of the feebate idea, especially at the national level.

(2) There is a need for a greater understanding of potential benefits and costs of state level and multi-state coordinated feebate programs.

(3) There has not been sufficient pilot testing of feebate programs in the United States to provide implementation experience.

CCS assessed recent studies of potential GHG emission reductions from a national feebate program based on modeling work conducted by the US Department of Energy's Oak Ridge National Laboratory (ORNL). CCS also reviewed other relevant recent studies and analyses of feebates conducted by the Canadian government, the State of California, and PIRG. The ORNL and other studies assume a national feebate rate high enough to produce responses from both consumers and manufacturers. The ORNL's estimate of the national potential for reduction in carbon dioxide emissions is approximately 11 MMTCO2e in 2010 and 66 MMTCO2e in 2020.

Some attempts have recently been made to estimate the GHG emissions reduction potential from individual state feebate programs, including programs proposed for the states of Arizona and California. For example, a recent PIRG analysis suggests that a single state feebate program for Arizona would result in an estimated 0.1 MMtCO2e

GHG emissions reductions in 2020. These recent estimates of the potential impacts of individual state programs are contingent upon assumptions and analytical methods that have not undergone thorough peer review. Therefore, the results of these analyses are preliminary and should be interpreted with some caution. Further analysis and study of the potential benefits and costs of individual state and multi-state feebate programs would greatly increase confidence in projected results.

Key Uncertainties:

The results of a feebate program depend on manufacturer and consumer response, which are uncertain at this time.

Ancillary Benefits and Costs, if applicable:

Feebates would reduce criteria pollutants along with GHG emissions.

Feasibility Issues, if applicable:

Requires multi-state cooperation.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

TLU-9 Pay-As-You-Drive Insurance

Policy Description:

Pay-As-You-Drive (PAYD) insurance program (changing part of vehicle insurance payments from fixed charges to per-mile charges).

Policy Design:

Arizona would change insurance regulations to allow PAYD insurance; and initiate and promote an aggressive pilot of PAYD in 2008. Assuming this Pilot is successful, market penetration could increase to 100% by 2020. This could happen either through competitive pressure (increasing numbers of companies offer it in order to stay competitive) or through a change in state policy mandating PAYD at some point after it has been shown to work.

Pay as You Drive Insurance has been promoted by a variety of groups for reasons that include emissions reduction and safety (through decreased driving), and fairness (by changing insurance costs to more closely track the portion of individuals' risk that is created by miles driven). Some key questions and answers are presented below.

Q: Would PAYD penalize rural residents because they drive further than average?
A: Rates can be set—as most insurance rates are—for classes. PAYD rates would be charged within classes, so that a driver in that class (say, "rural") traveling the average distance would pay the same under PAYD as before.

Q: Does the technology exist to support PAYD?
A: Yes. The necessary equipment for remote mileage readings is standard on GM OnStar-equipped vehicles. Add-on equipment to relay mileage automatically has been added in several pilot projects for several hundred dollars. All MY1996 vehicles and newer have OBD (on-board diagnostics) that already electronically monitor mileage that can be quickly downloaded via transponder. And current odometers are tamper-proof enough to support yearly mileage readings with no additional technology.

Q: Is there any on-the-ground experience with PAYD?
A. Yes. Several companies around the world offer PAYD today. In English-speaking countries:

1) Progressive Insurance ran an initial 5,000-car pilot in Texas, which saw reductions in driving of ~20%. A subsequent pilot in Minnesota filled up its 4,800 spots quickly, and Progressive is now rolling it out in other states. https://tripsense.progressive.com/

2) GMAC Insurance and OnStar have announced a PAYD program.

3) The British insurance company Norwich Union offers PAYD in Britain. (http://www.norwichunion.com/pay-as-you-drive/index.htm).

4) North Central Texas Council of Governments and King County Metro (Seattle) have both recently concluded Requests for Proposals to conduct PAYD pilots (http://www.nctcog.org/trans/air/programs/payd/index.asp). No available results yet.

Any of these pilots could be useful sources of models for an Arizona pilot project.[8] See also the discussion in the AZ PIRG report (pp. 25-26).

Implementation Method(s):

Authorization and pilot project, followed by evaluation and promotion.

Related Policies/Programs in Place:

None cited.

Types(s) of GHG Benefit(s):

CO2 reductions.

Estimated GHG Savings and Costs Per MTCO2e:

	2010	2020	Units
GHG Emission Savings	~0	2.8	MMtCO2e
Net Present Value (2006-2020)		No net cost	$million
Cumulative Emissions Reductions (2006-2020)		Not quantified	MMtCO2e
Cost-Effectiveness		No net cost	$/tCO2e

[8] For additional information see: Kevin Maney, "For a price, would you let car insurer along for the ride?", *USA Today*, 8/3/05. http://www.usatoday.com/money/industries/technology/maney/2005-08-03-car-monitoring_x.htm ;Todd Litman, "Pay-As-You-Drive Vehicle Insurance: Converting Vehicle Insurance Premiums Into Use-Based Charges" http://www.vtpi.org/tdm/tdm79.htm; Dean Baker, "Insurance By the Mile", *Harper's Magazine*, June, 2006. http://harpers.org/bb-insurance-by-the-mile-2838238.html ; Ian W.H. Parry, "Is Pay-As-You-Drive Insurance: a Better Way to Reduce Gasoline than Gasoline Taxes?," Resources for the Future (www.rff.org/Documents/RFF-DP-05-15.pdf), 2005.

Data Sources, Methods and Assumptions:

CCS examined an Arizona PIRG report and compared its model results for estimated reductions in vehicle miles of travel with other studies of PAYD policies, including those produced by the Economic Policy Institute and Resources for the Future (RFF). Arizona PIRG conducted an analysis of the potential GHG reductions from a Pay-As-You-Drive (PAYD) automobile insurance policy. CCS found that the AZ PIRG estimates were comparable with other estimates, which ranged from 8 percent to 20 percent. As a result, the Arizona PIRG results for estimated reductions in vehicle miles of travel and greenhouse gas emissions reductions fell within the lower range of the comparable estimates. That is, the emissions reduction estimates are conservative.

AZ PIRG's analysis assumed that insurers are required to offer mileage-based insurance for certain elements of vehicle insurance, including collision and liability. AZ PIRG assumes the PAYD policy is required, phased in over time, and that all drivers in Arizona are eventually covered. (That is, AZ PIRG's analysis assumes a different path to 100% penetration than does CCS, but both assume that penetration reaches 100% by 2020.)

To calculate GHG savings, Arizona PIRG converted Arizona state automobile collision and liability insurance expenditures to an insurance cost per mile (6.4 cents per mile). Assuming insurance consumers pay 80 percent of their collision and liability insurance on a per-mile basis, drivers would be assessed about a 5.1-cent charge per mile. This per-mile insurance charge would reduce vehicle-miles traveled by about 8 percent, and light-duty vehicle carbon dioxide emissions by about 4 percent. (See AZ PIRG, "A Blueprint for Action," pp. 25-26) To put this charge in context, at 20 mpg, 5.1 cents/mile = ~$1/gallon of gasoline.

Key Uncertainties:

The specifics of the PAYD insurance programs are to be determined, and the actual effects of PAYD insurance on driver behavior are subject to some significant uncertainty.

Ancillary Benefits and Costs, if applicable:

Reductions in criteria air pollutants, reductions in crashes.

Feasibility Issues, if applicable:

The CCAG raised questions and potential concerns regarding disproportionate impacts on rural drivers.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

TLU-10 Low Rolling Resistance Tires

Policy Description:

Improve the fuel economy of the light duty vehicle (LDV) fleet by setting minimum energy efficiency standards for replacement tires and requiring that greater information about Low-Rolling Resistance (LRR) replacement tires be made available to consumers at the point of sale.

Policy Design:

- **Goal levels:** Require that replacement tires be LRR tires achieving an average 3% gain in fuel economy.
- **Timing:** The requirement would begin in 2008.
- **Parties:** Industry**,** AZDWM, ADOT, ADEQ

Implementation Method:

Manufacturers currently use LRR tires on new vehicles, but they are not easily available to consumers as replacement tires. When installing original equipment tires, carmakers use low rolling resistance tires as a way to contribute to meeting the federal automobile fuel economy (CAFÉ) standards. When replacing the original tires, consumers often purchase less efficient tires. Currently, tire manufacturers and retailers are not required to provide information about the fuel efficiency of replacement tires. In addition, there is no current minimum standard for fuel efficiency that all replacement tires must meet. The rolling resistance of the various tires consumers can purchase have significant variations depending on tread design, composition, cross-section geometry, and inflation pressure.

The program would include consideration of the technical feasibility and cost of such a program, the relationship between tire fuel efficiency and tire safety, potential effects upon tire life, and impacts on the potential for tire recycling. In addition, the program would exempt certain classes of tires that sell in low volumes, including specialty and high performance tires.

An appropriate State agency would initiate a fuel efficient tire replacement program. The program could include consumer education, product labeling, and minimum standards elements. These programs would be developed under a rule development process that would incorporate the best scientific information, including the results from tests of tires conducted by the tire manufacturers, the California Energy Commission, and other data reviewed by the National Academy of Sciences.

The minimum standard is likely to be less stringent than the energy efficiency of original tires provided by the automobile manufacturers on new purchase vehicles. Such a regulation would improve the fuel efficiency of the overall LDV fleet, but not necessarily the fuel efficiency of all tires since consumers would still make choices in the marketplace. The replacement tires in the future would be on average more fuel efficient than those historically purchased, but are likely to be on average not as fuel efficient as the tires included as original equipment by the automobile manufacturers.

Related Policies/Programs in Place:

In October of 2003, California adopted the world's first fuel-efficient replacement tire law. AB 844 is a "first-of-its-kind" law requiring energy efficient tires. AB 844 directed the California Energy Commission (CEC) to develop a State Efficient Tire Program. Specifically, AB 844 requires the CEC to: (1) develop a consumer education program, (2) require that retailers provide labeling information to consumers at the point of sale, and (3) promulgate through a rule development process a minimum standard for the fuel efficiency of replacement tires sold. The California rule development process is scheduled to begin in January 2007.

Estimated GHG Savings and Costs Per MTCO2e:

	2010	2020	Units
GHG Emission Savings	~0	0.8	MMtCO2e
Net Present Value (2006-2020)		Not quantified	$million
Cumulative Emissions Reductions (2006-2020)		Not quantified	MMtCO2e
Cost-Effectiveness		Not quantified	$/tCO2e

Data Sources, Methods and Assumptions:

- **Data Sources:** Studies by National Research Council, California Energy Commission, and Arizona PIRG
- **Quantification Methods:** CCS evaluated and compared a series of existing assessment, as follows:

At the request of the United States Congress, the National Research Council of the National Academy of Sciences (NRC/NAS) conducted a study of the feasibility of reducing rolling resistance in replacement tires. The 2006 NRC/NAS study made the following conclusions:

"Reducing the average rolling resistance of replacement tires by a magnitude of 10 percent is technically and economically feasible.

Tires and their rolling resistance characteristics can have a meaningful effect on vehicle fuel economy and consumption.

Although traction may be affected by modifying a tire's tread to reduce rolling resistance, the safety consequences are probably undetectable.

Reducing the average rolling resistance of replacement tires promises fuel savings to consumers that exceed associated tire purchase costs, as long as tire wears life is not shortened."

A 2003 study commissioned by the California Energy Commission found that about 300 million gallons of gasoline per year can be saved in that state with lower rolling resistance tires. A set of four low rolling resistance tires would cost consumers an estimated \$5 to \$12 more than conventional replacement tires. The efficient tires would reduce gasoline consumption by 1.5 to 4.5 percent, saving the typical driver \$50 to \$150 over the 50,000-mile life of the tires. Consumers would save more than \$470 million annually at current retail prices or approximately \$1.4 billion over the three-year lifetime of a typical set of replacement tires.

The Arizona PIRG report, "A Blueprint for Action," presents estimates for potential carbon dioxide emission reductions from a low-rolling resistance replacement tire program. The AZ PIRG estimate for GHG reductions from a fuel efficient tire program is 0.7 MMTCO2e in 2020. PIRG calculates an estimated 2.4 percent reduction in greenhouse gas emissions from the PIRG-calculated baseline. (See AZ PIRG, "A Blueprint for Action," pp. 22-23, 54)

The PIRG analysis uses a base case scenario that is different from the approved Arizona CCAG reference case scenario. As a result, the CCS quantification method used was to apply the 2.4 percent estimate of the emissions reductions to the CCAG reference case scenario, producing an emissions reduction that is higher than the 0.7 MMtCO2e estimated by AZ PIRG. The resulting CCS estimate for emissions reductions from fuel-efficient replacement tires is 0.8 MMtCO2e in 2020.

- **Key Assumptions:** The amount of greenhouse gas emissions reductions from this policy depends upon what the average fuel efficiency of replacement tires would be under such a policy and the rate at which consumers will replace their existing tires with more fuel-efficient tires.

Key Uncertainties:

The low rolling resistance fuel efficient tires program is based upon existing off-the-shelf technologies and products that already exist in the consumer marketplace. These tires are already available in the marketplace, and are comparable with the tires included as original equipment on new purchase light duty vehicles.

Ancillary Benefits and Costs:

Some reduction in criteria pollutants.

Feasibility Issues:

Some members of the group raised questions about potential safety and performance compared to conventional tires.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

TLU-11 Accelerated Replacement/Retirement of High-emitting Diesel Fleet

Policy Description:

Reduce GHG black carbon emissions from heavy-duty diesel vehicles by developing and implementing an incentives program in Arizona to accelerate the replacement and/or retirement of the highest-emitting diesel vehicles.

Policy Design:

Starting with the 2007 model year, the emission standards for new heavy-duty diesel vehicles will be significantly tightened. In conjunction with these more stringent emission standards, the sulfur content of diesel fuel will be lowered from 500 parts per million (ppm) to 15 ppm. These measures will combine to significantly reduce GHG black carbon emissions from heavy-duty diesel trucks and buses. However, a large number of older, more-polluting diesel vehicles will remain in the fleet. This measure is aimed at determining methods to incentivize the owners of these older vehicles to retire their vehicles early and replace them with vehicles meeting the 2007 emission standards.

- **Goal levels:** Assuming the model years eligible for diesel retrofits also make the most sense for accelerated retirement (e.g., they still have over 4 years of expected useful life and are not meeting the 2007 emission standards), a likely/reasonable scenario would be to target 25 percent of these eligible vehicles for replacement.
- **Parties:** Industry**,** ADEQ, local jurisdictions, school districts

Implementation Method(s):

<u>Information and education:</u> An information and education component will be needed to provide truck and bus owners, school districts, and municipal organizations with information regarding the significant GHG black carbon emission reductions that could be achieved by retiring certain truck or bus engines with high annual emissions and replacing them with vehicles meeting the new emission standards. Provide information on potential funding partners, grants, or loans available from a number of organizations for this purpose.

<u>Tools:</u> Develop a database tool to show the lifetime emission reductions that would be achieved from retiring specific truck and bus models as well as calculator to estimate the cost of purchasing a new vehicle on an accelerated schedule.

<u>Funding mechanisms or incentives:</u> Develop policies to incentivize truck and bus owners with high annual emissions to retire their vehicles on an accelerated basis.

Voluntary and or negotiated agreements: The program could be set up on a strictly voluntary basis.

State lead by example: The State of Arizona could lead by example by replacing their older/dirtier vehicles. Target fleet owners of older vehicles within the State for a pilot program aimed at replacing a number of that fleet's vehicles.

Related Policies/Programs in Place:

None cited.

Estimated GHG Savings and Costs Per MTCO2e:

Reductions are estimated at 0.09 to 0.18 MMtCO2e in 2010.

Data Sources, Methods and Assumptions:

- **Data Sources:** CCS, Arizona Greenhouse Gas Inventory and Reference Case Projections, 1990-2020, March 2006.
- **Quantification Methods:** Spreadsheet analysis using vehicle fleet size, assumptions on turnover and replacement, and emissions factors to calculate black carbon reductions.Assuming the model years eligible for diesel retrofits also make the most sense for accelerated retirement (e.g., they still have over 4 years of expected useful life and are not meeting the 2007 emission standards), the maximum reduction from replacing all of these eligible diesel trucks would be 0.34 to 0.73 MMtCO2e in 2010. A more likely/reasonable scenario would be to target 25 percent of these eligible vehicles for replacement. This would give a reduction of 0.09 to 0.18 MMtCO2e in 2010.
- **Key Assumptions:** A replacement rate of 25 percent.

Key Uncertainties:

Actual attainable replacement rates.

Types(s) of GHG Benefit(s):

This program will reduce black carbon emissions.

Ancillary Benefits and Costs, if applicable:

This program will also reduce emissions of PM, NOx, and toxics.

Feasibility Issues, if applicable:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

TLU-12 Biodiesel Implementation

Policy Description:

Increase market penetration of biodiesel fuels in Arizona by a mixture policies (voluntary and/or mandatory) to achieve feasible goals.

Policy Design:

Increase market penetration of biodiesel fuels in Arizona. (Ethanol reductions are presented under TLU-5.) Conduct a review of any technical impediments to biodiesel use, and, if these are not significant, proceed to policies and measures that significantly increase biodiesel use and substitution for conventional diesel fuel. Target programs to the best possible applications where they are most likely to be successful and with a certainty of obtaining significant GHG emission reductions. This measure will help to ensure that Arizona is actively pursuing and meeting or exceeding the alternative fuel penetration goals specified in this Act.

- **Goal levels:** 75% B2 penetration by 2010. Review the program success by 2015, considering the interactions of biodiesel blends with the ultra-low sulfur diesel to be sold nationally by 2010 and the implementation of new diesel vehicle emission standards starting in 2007, and determine whether further penetration of biodiesel fuel is desirable. If the program is determined to be successful at that point and supply of biodiesel is not an issue, set a goal of at 50% B20 penetration by 2020.
- **Timing:** See above.
- **Parties:** Industry**,** AZDWM, ADOT, ADEQ, local jurisdictions, school districts

Implementation Method(s):

Increased market penetration of biodiesel could, potentially, be implemented by a variety of means, including:

Information and education: An information and education component will be needed to let consumers know of product availability and associated performance issues, as well as the potential benefits of using these fuels.

Voluntary and or negotiated agreements: A program could be set up on a voluntary basis and target certain fleet segments. For example, a B20 biodiesel program (20% biodiesel blended with 80% petroleum diesel) in a truck fleet with older vehicles (e.g., without diesel particulate filters) should achieve success. Emergency vehicles and snow removal vehicles should not be included in such programs.

Codes and standards: In order for this program to be successful, the standards and enforcement recommended under policy TLU-5 (Standards for Alternative Fuels) should be in place first. The state could impose a mandatory biodiesel use requirement for fuel vendors, that goes beyond that the biofuels requirement in the Energy Security Act of 2005.

Pilots and demos: Have State of Arizona lead by example. Where practical, have State diesel vehicles begin using B10 and B20 fuel and report on experience to industry.

Related Policies/Programs in place:

HR 6, the Energy Security Act of 2005, established a Renewable Fuel Standard that requires that 4 billion gallons of ethanol and/or biodiesel be used in 2006 and increasing to at least 7.5 billion gallons in 2012.

Types(s) of GHG Benefit(s):

This measure will reduce emissions of CO2 by 78 percent when compared to CO2 emissions from diesel fuel on a full life cycle basis.

Estimated GHG Savings and Costs Per MTCO2e:

	2010	2020	Units
GHG Emission Savings	0.11	1.08	MMtCO2e
Net Present Value (2006-2020)		Not quantified	$million
Cumulative Emissions Reductions (2006-2020)		8.8-17.5	MMtCO2e
Cost-Effectiveness		Not quantified	$/tCO2e

Data Sources, Methods and Assumptions:

- **Data Sources: "**Final Arizona Greenhouse Gas Inventory and Reference Case Projections 1990-2020," The Center for Climate Strategies, June 2005. "Documentation of Inputs to Macroeconomic Assessment of the Climate Action Team Report to the Governor and Legislature," California Climate Action Team, January 2006. *A Life Cycle Inventory of Biodiesel and Pertoleum Diesel for Use in an Urban Bus,* Sheehan et al. May 1998.
- **Quantification Methods:** The quantity of diesel fuel projected to be used in Arizona in the AZ GHG inventory were multiplied by the penetration rate of biodiesel fuel

(0.02*0.75 for 2010, 0.20*0.5 for 2020). Emission reductions from this option were quantified based on multiplying the biodiesel fuel penetration by a CO_2 emission factor of 1.03*10-8 $MMtCO_2$/gal and then applying a 78% reduction in CO_2 to account for the biodiesel CO_2 reduction. (Sheehan, et al, May 1998).

- **Key Assumptions:** This analysis assumes a 78% reduction in CO_2 emissions from biodiesel fuel and resolution of barriers to market penetration.

Key Uncertainties:

GHG benefits will depend on biodiesel feedstock and production process used. Benefits may differ for older trucks versus those meeting 2007 emission standards. The effect of biodiesel on engines meeting new pollution standards with low sulfur diesel is questioned by some in the industry.

Ancillary Benefits and Costs, if applicable:

The use of biodiesel will also reduce emissions of PM, SO_2, CO, and HC in older vehicles (emission reduction potential reduced with new technology engines equipped with catalysts and diesel particulate filters). EPA has reported that the use B20 biodiesel can lead to a 21% reduction in HC, 11% reduction in CO, and a 10% reduction in PM. Toxic emission reductions can also be significant. However, biodiesel can lead to increased exhaust emissions of NOx and some air toxics, depending on feedstock and blend level. EPA reports a 2% increase in NOx emissions for B20 blends. Effects on newer diesel vehicles are likely to be different. An increased penetration of biofuels reduces our foreign fossil fuel dependency. Biodiesel reduces energy content which reduces fuel economy: 0.9-2.1% reduction for B20 and 4.6-10.6% reduction for B100. Biodiesel typically costs more than diesel (EPA estimates a 30 to 40 cents per gallon increase.)

Feasibility Issues, if applicable:

Some members of the group were concerned that biodiesel use could lead to operational problems, particularly at low temperatures, and could also lead to operational problems on new technology engines equipped with diesel particulate filters. Others felt that these issues have been resolved and would not impact future biodiesel use.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

TLU-13 State Lead-By-Example (Procurement and SmartWay)

Policy Description:

Arizona state agencies "could lead by example" by enacting procurement policies and or joining the EPA SmartWay program that result in adoption of lower emitting vehicle fleets. There are three primary components of the program: creating partnerships, reducing all unnecessary engine idling, and increasing the efficiency and use of rail and intermodal operations.

Policy Design:

Goals, levels, timing and participation in procurement or voluntary standards programs were not specifically considered, and need to be developed in the future.

Implementation Method(s):

There are numerous activities Arizona could pursue to participate fully in enacting procurement policies or programs such as SmartWay. For example:

State agencies with vehicle fleets could sign on as SmartWay carrier partners. They would then measure their environmental performance with the FLEET model and come up with a plan to improve that performance. The partnership provides information and suggested strategies to improve fuel economy and environmental performance of vehicle fleets.

State agencies that buy transportation services, or ship goods could sign on as SmartWay shippers. As shipper partners, state agencies would seek to select SmartWay partners when they purchased the services of carriers. One way that the state could help would be to add SmartWay certification to the list of factors that they may consider when selecting carriers. Alternatively, they could just encourage the carriers that they do business with to join the partnership. Shippers can also implement direct strategies, for instance developing no-idle policies for their loading areas.

State agencies could sign onto SmartWay as affiliates. As affiliates, they would help to distribute information on the program to interested parties. This could be as easy as putting a link on their web site, or it could involve a more active role.

Related Policies/Programs in Place:

There are three Arizona based carriers in the program now: Knight Transportation, Inc., McKelvey Trucking Company, and Swift Transportation Co.

Types(s) of GHG Benefit(s):

CO_2, black carbon

Estimated GHG Savings and Costs Per MTCO2e:

Not quantified

Data Sources, Methods and Assumptions:

Not applicable

Key Uncertainties:

None cited.

Ancillary Benefits and Costs:

Some reduction in criteria pollutants.

Feasibility Issues:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

TLU-14 60 MPH Speed Limit for Commercial Trucks

Policy Description:

Reduce speed limit for commercial trucks to 60 mph.

Policy Design:

Goals, levels, timing and participation in revised speed limit policies were not specifically considered, and need to be developed in the future.

Implementation Method(s):

Regulatory standard combined with information and education.

Related Policies/Programs in Place:

Current speed limits are as high as 75 mph, depending on the highway segment.

Types(s) of GHG Benefit(s):

CO2, black carbon

Estimated GHG Savings and Costs Per MTCO2e:

Not quantified.

Data Sources, Methods and Assumptions:

Not quantified.

Key Uncertainties:

Ability to enforce a speed limit significantly lower than current policy.

Ancillary Benefits and Costs:

Some reduction in criteria pollutants.

Feasibility Issues:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

Table 4.
Agriculture and Forestry Technical Work Group
Summary List of Pending Policy Options

#	Policy Name	GHG Savings ($MMtCO_2e$)	Cost Effectiveness ($\$/tCO_2e$)	Status
A-1b	Manure Management – Land Application	Not Quantified[b]	Not Quantified[b]	Pending
A-4	Change Feedstocks (optimize for CH4 and/or N_2O reduction)	2010: 0.03 2020: 0.07	$165	Pending
A-6	Grazing Management	Not Quantified[b]	Not Quantified[b]	Pending
A-8	Agricultural Land Protection from Developed Uses	2010: 0.08 2020: 0.2	$65	Pending
[b] Not quantified due to uncertainty in the potential GHG reduction benefits. [d] Additional work needed to determine if the elements of this policy can be incorporated into existing programs.				

NOTES:

Policy overlaps: GHG reductions associated with biomass energy utilization from biomass supply quantified from options F3a and F3b will overlap with GHG reductions achieved by commercializing biomass gasification/combined cycle technology in option F4 (since the biomass energy from F3a and b will serve as input to F4). Therefore, GHG reductions have been quantified under F3a and b only.

A-1b Manure Management – Land Application

Policy Description:

Reduce N2O emissions from daily spread and other land application of dairy and feedlot cattle manure through the use of better application methods, such as direct injection of liquid waste. These application methods are designed to reduce contact of manure nitrogen with air (lowering the rate of denitrification) and the amount of manure nitrogen loss via leaching and runoff.

Policy Design:

- **Goal levels:** Program goal of changing manure land application methods for 20% of beef and dairy cattle by 2010 and 50% of beef and dairy cattle by 2020.
- **Timing:** See goal above.
- **Parties:** AZ Department of Agriculture, Arizona Department of Environmental Quality, Agricultural Extension Offices, dairy and feedlot operators.

Implementation Method(s):

Not considered.

Related Policies/Programs in Place:

Not considered.

Types(s) of GHG Benefit(s):

- N2O: Reduces N20 emissions by minimizing manure nitrogen contact with air; or nitrogen losses via leaching or runoff which result in subsequent N20 emissions.

Estimated GHG Savings and Costs per MTCO2e:

- GHG potential in 2010, 2020: Not Quantified (see discussion under Data Sources below).
- Net Cost per $MMTCO_2e$ in 2010, 2020: Not Quantified.

Data Sources, Methods and Assumptions:

- **Data Sources:** There are little data available on the reductions of N2O associated with different manure application methods. Most previous studies have focused on reductions in NH3 (ammonia) emissions, increased nitrogen uptake by crops, or lower nitrogen runoff. CCS identified one source of information that suggested that subsurface application of manure could lower nitrogen oxide (NO) emissions, but actually raises N2O emissions.[9]

- **Quantification Methods:** Due to the lack of available data on GHG reduction potential, benefits and costs for this option were not quantified.
- **Key Assumptions:** Not applicable.

Key Uncertainties:

See data sources above.

Ancillary Benefits and Costs:

- Reduction of ammonia, VOC emissions, and odor.
- Increased in nitrogen utilization by crops and pastures.
- Decreased leaching and runoff of nitrogen to ground and surface water.

Feasibility Issues:

Data were not identified to assess the technical feasibility of this option (i.e., N2O emission reductions due to better application methods).

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

[9] http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/004/Y2780E/y2780e02.htm.

A-4 Change Livestock Feedstocks

Policy Description:

Reduce methane emissions from beef and dairy cattle by changing (optimizing) livestock feedstocks.

Policy Design:

- **Goal levels:** Change feedstock for 50**%** of dairy and feedlot cattle to a feed regimen that lowers methane emissions.
- **Timing:** 20% of dairy and feedlot cattle on methane lowering diet by 2010, 50% by 2020.
- **Parties:** Beef and dairy producers, industry associations, agricultural extension offices, Arizona Department of Agriculture.
- **Other:**

Implementation Method(s):

Not determined.

Related Policies/Programs in Place:

TWG members indicated that a significant portion of Arizona cattle is fed cottonseed as part of their regimen. The incremental benefit of additional edible oil supplementation to lower methane emissions is unknown.

Types(s) of GHG Benefit(s):

- CH4: Addition of edible oils to feedstocks can reduce CH4 emissions from enteric fermentation in cattle. Vegetable oils are more dense digestible energy sources that require less fermentation in the rumen for energy to be released.

Estimated GHG Savings and Costs per MTCO2e:

- GHG potential in 2010, 2020: 0.03 MMtCO2e in 2010, 0.07 MMtCO2e in 2020
- Net Cost per $MtCO_2e$ in 2010, 2020: $165/MtCO2e

Data Sources, Methods and Assumptions:

- **Data Sources:** The populations of dairy and feedlot cattle in Arizona in 2004 were obtained from the USDA[10]. Emission reductions from the addition of edible

[10] Arizona Annual Livestock, May, 2004, USDA NASS, http://www.nass.usda.gov/az/lvstk/2004/040525al.pdf

oil to cattle feedstocks and the amount of oil consumed per head was taken from a study on the effects of various feed additives on enteric fermentation methane emissions[11]. Costs for edible oils were obtained from the USDA[12].

- **Quantification Methods:** Cattle populations were assumed to remain constant from 2004 levels to 2020. Emission savings were estimated by applying the 21% emission reduction to the estimated methane emissions for 20% of the population in 2010 and 50% of the population in 2020. Costs were estimated by multiplying the cost of soybean oil ($0.23 per lb) by the amount consumed by each head of cattle (400 g/head/day or 0.88 lb/head/day).
- **Key Assumptions:** Cattle populations were assumed to remain constant from 2004 levels to 2020. Soybean oil was chosen to estimate costs, because it is less expensive than sunflower oil (the oil used in the emissions study). It was assumed that any edible oil would produce a similar reduction of methane emissions.

Key Uncertainties:

As noted above, currently many AZ cattle have cottonseed included as part of their feed. Therefore, it is unclear whether there is a significant incremental benefit achieved by the inclusion of edible oils into the feeding regimen.

Ancillary Benefits and Costs:

Potential higher value of meat products from cattle fed edible oils.

Feasibility Issues:

See uncertainties above.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD

[11] McGinn et al., 2004, "Methane emissions from beef cattle: Effects of monenesin, sunflower oil, enzymes, yeast, and fumaric acid." http://jas.fass.org/cgi/content/full/82/11/3346

[12] Oil Crops Outlook, Feb, 2006, USDA ERS, http://usda.mannlib.cornell.edu/reports/erssor/field/ocs-bb/2006/ocs06bf.pdf

A-6 Rotational Grazing/Improve Grazing Crops and/or Management

Policy Description:

Increase carbon sequestration in grazing lands through rotational grazing, improvement of grazing crops, and/or grazing management.

Policy Design:

- **Goal levels:** Program goal of bringing **X** acres of poorly managed grazing land under new management practices.
- **Timing:** Acres of grazing land brought under new management practices by 2010, 2020 and 2050.
- **Parties:** Not considered.

Implementation Method(s):

Not considered.

Related Policies/Programs in Place:

None identified.

Types(s) of GHG Benefit(s):

- CO2: Carbon savings (sinks) are a result of enhanced sequestration on grazing lands. Using grazing management techniques that elevate the health status of plants on grassland ecosystems enhances sequestration.

Estimated GHG Savings and Costs per MTCO2e:

- GHG potential in 2010, 2020: Not determined due to lack of data.
- Net Cost per $MMtCO_2e$ in 2010, 2020: Not determined due to lack of data.

Data Sources, Methods and Assumptions:

- **Data Sources:** The TWG was unable to find sufficient information to assess the benefits and costs of this option. No data were found to identify the grazing lands in AZ, where different management practices could be implemented to increase carbon sequestration. Further, discussions with TWG members and an outside expert did not reveal a significant potential for enhancing soil or aboveground carbon in AZ grazing lands.

Managing native vegetation on rangelands in Arizona does not represent a reliable sink for sequestering carbon in soils in the near term (10 year period). Low (<10"' average precipitation) and erratic rainfall precludes a consistent sequestration response of sufficient amounts to warrant making this option a high priority compared to other emission reduction and sequestration options. However, the management of rangelands with existing technologies to improve soil and vegetation conditions over longer periods does represent an important strategy for reducing losses of carbon and increasing soil carbon.

- **Quantification Methods:** Not quantified (see data sources above).
- **Key Assumptions:** not applicable.

Key Uncertainties:

None cited.

Ancillary Benefits and Costs:

Higher quality grassland habitat for wildlife.

Feasibility Issues:

Additional research is needed to assess the feasibility of this option in AZ (see Data Sources above).

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

Members of the TWG were not comfortable in moving forward with this option due to the need for additional information to assess its technical feasibility in AZ (i.e., identification of rangelands where changes in management practices could achieve positive carbon sequestration returns). Rangelands where significant above and belowground carbon could be sequestered occur in areas of the state that receive adequate precipitation (generally above 5,000 feet). These areas are generally not the grazing lands that were historically damaged by overgrazing (desert scrub areas).

A-8 Reduce Permanent Conversion of Farm and Rangelands to Developed Uses

Policy Description:

Reduce the rate at which existing crop and rangelands are converted to developed uses. The carbon sequestered in soils and aboveground biomass is higher in crop and rangelands than in developed land uses.

Policy Design:

- **Goal levels:** Program goal of reducing the rate of crop and rangeland loss to 50% of the loss rate from 1982-1997 by 2020.
- **Timing:** 20% reduction in loss rate by 2010, 50% by 2020.
- **Parties:** County Governments, non-government organizations (land trusts), AZ State Land Department.

Implementation Method(s):

Information and Education; Technical Assistance; Voluntary or Negotiated Agreements; Funding Mechanisms or Incentives.

Related Policies/Programs in Place:

None identified.

Types(s) of GHG Benefit(s):

CO2: Conservation of agricultural lands retains the ability of the land to sequester carbon in soil and biomass. Agricultural lands tend to hold more carbon than developed uses. These direct benefits were quantified below. Retention of agricultural lands also indirectly reduces CO2 emissions by encouraging less suburban sprawl and the associated transportation-related emissions.

Estimated GHG Savings and Costs per MTCO2e:

- GHG potential in 2010, 2020: 0.08 MMtCO2e; 0.20 MMtCO2e.
- Net Cost per $MtCO_2e$: $65/MtCO2e.

Data Sources, Methods and Assumptions:

- **Data Sources:** The number of acres that moved from cropland, pasture, and rangeland categories to developed uses between 1982 and 1997 was obtained from the USDA Natural Resource Inventory (NRI). Agricultural land soil carbon data was taken from a study in *Soil Science* that compiled data for cultivated and uncultivated land with various soil types[13]. Estimates of soil carbon on Arizona rangeland was obtained from the STATSGO/SSURGO SOC database.

Costs for agricultural land can vary widely from as low as $200/acre in rural areas without significant water supply to as much as $100,000/acre in prime locations with high development potential.[14] Costs were estimated for this option using a cost of $2,000/acre for conservation easement. This cost represents the nationwide average determined by the American Farmland Trust.[15]

- **Quantification Methods:** The number of acres of cropland, pasture, and rangeland converted to developed uses between 1982 and 1997 was divided by 15 years to give the average number of acres lost each year. The number of acres to be saved in 2010 and 2020 were estimated by multiplying the average rate for 1982-1997 by 20% and 50%, respectively. The amount of CO2 emissions savings were estimated by assuming that for each acre lost to development, 10,000 sq ft (0.23 acre) losses 100% of the soil carbon. The remainder of the acre losses 25% of soil carbon.
- **Key Assumptions:** Aboveground carbon stocks for agricultural lands and rangeland was assumed to be small compared to soil carbon. For each acre of land lost to development, 10,000 sq ft is assumed to loss 100% of the soil carbon. This area represents the area in buildings, streets, and other structures that cover the soil. A loss of 25% of the soil carbon is assumed for the remainder of the acre.

Key Uncertainties:

The main areas of uncertainty are the existing soil carbon stocks and the change in soil carbon when land is developed.

Ancillary Benefits and Costs:

Directing growth to more efficient locations may also reduce transportation emissions.

Feasibility Issues:

None identified.

Status of Group Approval:

Completed

[13] Mann, L.K. 1986. Changes in soil carbon storage after cultivation. Soil Science 142(5):279-288.
[14] Bob Findling, The Nature Conservancy, and personal communication with H. Lindquist, CCS, June 2006.
[15] American Farmland Trust, A National View of Agricultural Easement Programs, http://www.aftresearch.org/PDRdatabase/NAPidx.htm.

Level of Group Support:

Unanimous

Barriers to Consensus:

None cited.

Table 5.
Cross Cutting Issues Technical Work Group
Summary List of Pending Policy Options

#	Policy Name	Status
CC-3	State Greenhouse Gas Registry	Pending

CC-3 State Greenhouse Gas Registry

Policy Description:

Measurement and recording of GHG emissions reductions at a macro- or micro-scale level in a central repository with a "transaction ledger" capacity to support tracking, management, and "ownership" of emission reductions as well as to encourage GHG reductions, to enable potential recognition, baseline protection, and/or the crediting of actions by implementing programs and parties in relation to possible emissions reduction goals, and to provide a mechanism for regional, multi-state, and cross-border cooperation. Subject to appropriately rigorous quantification, GHG registration should not be constrained to particular sectors, sources, or approaches so as to encourage GHG mitigation activities from all quarters.

Policy Design:

Recommendations for key registry design characteristics build off the GHG Reporting policy option (CC-2) and are noted in the "*GHG Registry Design Options Matrix*" available at www.azclimatechange.us (under the Cross Cutting Issues Work Group link). Elements include:

- Geographic applicability at least at the statewide level and as broadly (i.e., regionally or nationally) as possible.
- Allowing sources to start as far back chronologically as good data exists, as affirmed by third-party verification, and allowing registration of project-based reductions or "offsets" that are equally rigorously quantified.
- Incorporating adequate safeguards to ensure that reductions aren't double-counted by multiple registry participants; providing appropriate transparency; and allowing the state to be a valid participant for reductions associated with its programs, direct activities, or efforts.
- Striving for maximum consistency with other state, regional, and/or national efforts; greatest flexibility as GHG mitigation approaches evolve; and providing guidance to assist participants.
- **Goal levels:** Not applicable.
- **Timing:** ASAP after GHG reporting is operating.
- **Parties:** Probably overseen by ADEQ; costs shared by participants benefiting from the registry.

Implementation Method(s):

Base the Arizona registry to extent possible on existing state registry programs, with augmentation and modification as needed to cover the full suite of potential state and regional programs and policies in the future.

Related Policies/Programs in Place:

None cited.

Types(s) of GHG Benefit(s):

All GHG's.

Estimated GHG Savings and Costs per MTCO2e:

Not applicable.

Data Sources, Methods and Assumptions:

Not applicable.

Key Uncertainties:

None cited.

Ancillary Benefits and Costs:

None cited.

Feasibility Issues:

None cited.

Status of Group Approval:

Pending

Level of Group Support:

TBD

Barriers to Consensus:

TBD